

NOTICE OF EXPRESS MAILING

Express Mail Mailing Label Number: EL740518574US

Date of Deposit with USPS: February 19, 2002

Person making Deposit: Blake Johnson

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Examiner: K. Chen

Group Art No.: 1765

Applicant(s): Kei-Yu Ko et al.

Filing date: November 13, 2000

Serial No.: 09/711,324

For (title): ETCHANT WITH SELECTIVITY  
FOR DOPED SILICON DIOXIDE  
OVER UNDOPE SILICON  
DIOXIDE AND SILICON NITRIDE,  
PROCESSES WHICH EMPLOY THE  
ETCHANT, AND STRUCTURES  
FORMED THEREBY

TRANSMITTAL OF REPLY BRIEF

Commissioner of Patents and Trademarks  
Washington, D.C. 20231

Sir:

Transmitted herewith in triplicate is the REPLY BRIEF in this application further to the Examiner's Answer dated December 27, 2001.

Any additional appeal fees which are not otherwise submitted herewith or which are insufficient should be charged to deposit account no. 20-1469. A duplicate copy of this notice is enclosed. Please address all communications in connection with this appeal to the address indicated below.

Respectfully submitted,



Brick G. Power  
Reg. No. 38,581  
TRASK BRITT  
P.O. Box 2550  
Salt Lake City, UT 84110-2550  
(801) 532-1922

Date: February 19, 2002  
Enclosures: As identified above  
BGP/djp

RECEIVED

FEB 25 2002

TC 1700

2/22/02  
#13  
wa  
2/25/02  
Serial No. 09/711,324

**PATENT**

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES**

**In re Application of:** Kei-Yu Ko et al.

**Serial No.:** 09/711,324

**Filed:** November 13, 2000

**For:** ETCHANT WITH SELECTIVITY FOR  
DOPED SILICON DIOXIDE OVER  
UNDOPED SILICON DIOXIDE AND  
SILICON NITRIDE, PROCESSES WHICH  
EMPLOY THE ETCHANT, AND  
STRUCTURES FORMED THEREBY

**Examiner:** K. Chen

**Group Art Unit:** 1765

**Attorney Docket No.:** 3526.4US (97-1136.4)

**NOTICE OF EXPRESS MAILING**

Express Mail Mailing Label Number: EL740518574US

Date of Deposit with USPS: February 19, 2002

Person making Deposit: Blake Johnson

**REPLY BRIEF**

Commissioner of Patents and Trademarks  
Washington, D.C. 20231

Attention: Board of Patent Appeals and Interferences

Sirs:

This brief, which is in reply to the Examiner's Answer mailed by the Patent Office on  
December 27, 2001, is submitted in TRIPLICATE. 37 C.F.R. § 1.193(b).

ARGUMENT

**I. Rejections Under 35 U.S.C. § 103(a)**

**A. Summary of Response to the Obviousness Rejections**

It is respectfully submitted that, with respect to the 35 U.S.C. § 103(a) rejections of claims 1-38 of the referenced application, the Office has not met its substantial burden of establishing a *prima facie* case of obviousness.

First, it is respectfully submitted that one of ordinary skill in the art, prior to the earliest priority date for the referenced application, would not have been motivated to combine the cited references in the manner asserted by the Examiner because neither Bosch, Ding, or the knowledge generally available to one of ordinary skill in the art provides a motivation or suggestion to combine. It is also respectfully submitted that Ding teaches away from combination with Bosch. Second, no reasonable expectation of success has been established. Third, the cited references do not teach or suggest all the limitations of the claimed invention.

**B. Summaries of Cited Prior Art**

The relevant teachings of Bosch and Ding are summarized for the convenience of the Board of Appeals.

Bosch teaches a dry etch process in which a chemical combination that includes CHF<sub>3</sub> (Freon-23) and neon (Ne) is used to etch doped silicon oxide with selectivity over undoped silicon oxide, silicon nitride, silicide, and silicon. *See, e.g.*, col. 2, lines 34-44. Therefore, any of these materials may be used as an etch stop when a doped silicon oxide is being dry etched with

the disclosed combination of solely gaseous  $\text{CHF}_3$  and Ne. *See, e.g.*, col. 4, lines 43-48. The  $\text{CHF}_3$  (Freon-23) and neon (Ne) mixture is the only chemical combination disclosed, taught, or suggested in Bosch. Therefore, Bosch does not disclose, teach or suggest a dry etchant chemical combination that includes  $\text{C}_2\text{H}_x\text{F}_y$ , where x is an integer from three to five, inclusive, y is an integer from one to three, inclusive, and  $x + y = 6$ . In addition, since Bosch does not teach or suggest this dry etchant chemical combination, Bosch necessarily does not teach or suggest that the doped silicon oxide is dry etched with such a chemical combination or that such a dry etchant chemical combination is used to dry etch doped silicon oxide with selectivity over undoped silicon oxide.

Ding teaches, among other things, a dry etch process in which an etchant chemical combination that includes a fluorocarbon gas, an ammonia ( $\text{NH}_3$ ) generating gas, and a carbon-oxygen gas is used to etch dielectric materials, such as doped and undoped silicon dioxide. *See, e.g.*, col. 2, lines 32-43. Ding also teaches that the etchant chemical combination selectively removes dielectric materials, such as doped and undoped silicon oxides, over underlying substrate materials, such as silicon or gallium arsenide. *See, e.g.*, col. 3, lines 49-54. Ding further provides that the etchant chemical combination etches dielectric materials with selectivity over photoresist materials and polysilicon. Col. 7, lines 44-49. Importantly, Ding teaches that the  $\text{NH}_3$  generating gas forms gaseous and liquid  $\text{NH}_3$ -generating phases that adsorb on the substrate during the etching process and react with the fluorohydrocarbon gas on the surface of the substrate. Col. 6, lines 32-37. Among the various fluorocarbons that are specifically disclosed as useful in the etchant chemical combination are  $\text{CHF}_3$  and  $\text{C}_2\text{H}_4\text{F}_2$ . *See, e.g.*, col. 2,

line 62, to col. 3, line 2. However, Ding does not disclose, teach, or suggest that its chemical combination, or any other completely dry gaseous etchant chemical combination that includes  $C_2H_4F_2$ , is used to etch doped silicon oxide with selectivity over undoped silicon oxide.

**C. Arguments for Patentability of Claims 1-38**

1. *No Motivation to Combine the Teachings of the Cited References Exists*

It is respectfully submitted that one of ordinary skill in the art would not be motivated to use an etchant comprising  $C_2H_xF_y$  as a component of a dry etchant that is formulated to etch doped silicon dioxide with selectivity over at least undoped silicon oxide, where x is an integer from three to five, inclusive, y is an integer from one to three, inclusive, and  $x + y = 6$ , based on the teachings of Bosch, Ding, and the knowledge generally available to one of ordinary skill in the art at the priority date for the above-referenced application.

M.P.E.P. § 2142 provides:

The initial burden is on the examiner to provide some suggestion of the desirability of doing what the inventor has done. 'To support the conclusion that the claimed invention is directed to obvious subject matter, either the references must expressly or impliedly suggest the claimed invention or **the examiner must present a convincing line of reasoning** as to why the artisan would have found the claimed invention to have been obvious in light of the teachings of the references.' *Ex parte Clapp*, 227 USPQ 972, 973 (Bd. Pat. App. & Inter. 1985) (emphasis added).

Thus, the Office's burden of setting forth a *prima facie* case of obviousness is substantial.

M.P.E.P. § 2142 further provides:

When the motivation to combine the teachings of the references is not immediately apparent, **it is the duty of the examiner to explain why the**

**combination of teachings is proper.** *Ex parte Skinner*, 2 USPQ2d 1788 (Bd. Pat. App. & Inter. 1986) (emphasis added).

It is respectfully submitted that the references do not expressly or impliedly suggest the claimed invention. In addition, the Examiner has not provided a convincing line of reasoning to support the Office's assertion that one of ordinary skill in the art would have been motivated by Bosch, Ding, or the teachings generally available in the art to combine the teachings of the cited references in the manner asserted in the Examiner's Answer.

Rather, the Examiner summarily states that "it would be obvious to one skilled in the art that CHF<sub>3</sub> and C<sub>2</sub>H<sub>4</sub>F<sub>2</sub> are equivalent, [that they] contain similar etching characteristics, [and that] substitution of one for the other for etching dielectric layer[s] would have been anticipated to produce an expected result." Examiner's Answer, page 3. Furthermore, the examiner states that since CHF<sub>3</sub> and C<sub>2</sub>H<sub>4</sub>F<sub>2</sub> are equivalent, it would be obvious to modify Ding using the principles in Bosch to provide the requisite etching selectivity. Examiner's Answer, page 4. However, no support or evidence is offered by the Office to support the assertion that CHF<sub>3</sub> and C<sub>2</sub>H<sub>4</sub>F<sub>2</sub> are equivalent.

The Examiner appears to suggest that CHF<sub>3</sub> and C<sub>2</sub>H<sub>4</sub>F<sub>2</sub> are equivalent because they are listed together as fluorohydrocarbon gases that may be used as etchants in Ding. However, the "mere fact that components are claimed as members of a Markush group cannot be relied upon to establish the equivalency of these components." M.P.E.P. § 2144.06. In addition, "in order to rely on equivalence as a rationale supporting an obviousness rejection, the equivalency must be recognized in the prior art, and cannot be based on applicant's disclosure or the mere fact that the

components at issue are functional . . . equivalents.” M.P.E.P. § 2144.06. Neither Ding nor Bosch teaches or suggests that  $\text{CHF}_3$  and  $\text{C}_2\text{H}_4\text{F}_2$  are equivalents that may be used as components of a dry etchant that is formulated to selectively etch doped silicon dioxide over undoped silicon oxide because Bosch only discloses using  $\text{CHF}_3$  as an etchant to selectively etch doped silicon dioxide over undoped silicon oxide. While Ding discloses using both  $\text{CHF}_3$  and  $\text{C}_2\text{H}_4\text{F}_2$  to etch doped silicon dioxide and undoped silicon oxide, the selectivity of this etching is limited: both doped and undoped silicon dioxide are etched with selectivity over photoresist materials, not with selectivity for one over the other.

The Examiner has also apparently suggested that  $\text{CHF}_3$  and  $\text{C}_2\text{H}_4\text{F}_2$  are equivalent because the etchant systems in both Ding and Bosch disclose the use of  $\text{CHF}_3$  as a possible component of the etchant systems. However, Ding and Bosch do not provide the motivation to combine the teachings of Ding and Bosch in the manner suggested in the Examiner’s Answer. In fact, Bosch warns against reading any such motivation into the references by disclosing that, although many different gaseous media have been used in dry etching, successful use of etchants or etchant combinations to achieve a desired result often depends on *chance* due to the number of variables involved, including the materials to be etched, the selectivity, and the degree of anisotropy. Column 1, line 57-Column 2, line 5.

While  $\text{CHF}_3$ , a fluoromethane, is known in the art to be useful with other components of a dry etchant chemical combination to etch doped silicon oxide with some selectivity over undoped silicon oxide, no support has been provided for the assertion that one of ordinary skill in the art would have been motivated to use  $\text{C}_2\text{H}_x\text{F}_y$ , which is a fluoroethane, as a dry etchant or in a dry

etchant chemical combination that etches doped silicon dioxide with selectivity over undoped silicon oxide. Nor has any support been provided for the assertion that one of ordinary skill in the art would have been motivated to use  $C_2H_xF_y$  of the type recited in the pending claims as a dry etchant that etches doped silicon dioxide with selectivity over undoped silicon oxide.

If, as the Examiner suggests, all fluorocarbon compounds listed in Ding should have similar etching properties, evidence of another fluorocarbon compound that is used in a chemical combination that etches doped silicon dioxide with selectivity over undoped silicon dioxide should be available. However, no such evidence has been provided. Furthermore, no evidence, other than the Appellants' disclosure, indicates that the  $C_2H_xF_y$  class of fluorocarbon compounds etches doped silicon dioxide with selectivity over undoped silicon dioxide or silicon nitride.

While  $CHF_3$  and  $C_2H_xF_y$  are in the same general class of compounds, the fluorohydrocarbons, it is known that members of a general group of chemical compounds often have very different properties. Therefore, one of ordinary skill in the art could not readily determine whether two fluorocarbons, such as  $CHF_3$  and  $C_2H_xF_y$ , are equivalent with respect to their utility in dry etching doped silicon dioxide with selectivity over undoped silicon dioxide without undue experimentation. In other words, one of ordinary skill in the art could not readily predict whether  $CHF_3$  and  $C_2H_xF_y$  would have similar etching properties.

In summary, the Examiner has not provided support or evidence for the assertion that  $CHF_3$  and  $C_2H_xF_y$  are equivalent. For these reasons, it is respectfully submitted that a convincing line of reasoning has not been provided as to the propriety of combining the cited references. Since one of ordinary skill in the art would not have been motivated by the teachings of either



Bosch or Ding, or by the knowledge generally available to those of ordinary skill in the art, to combine the cited references to produce the claimed invention, the rejection of claims 1-38 is improper and should be withdrawn.

2. *The Cited References Do Not Teach or Suggest All the Claim Limitations*

It is respectfully submitted that, when taken alone or in combination, Bosch and Ding do not teach or suggest every element of any of claims 1-38. Specifically, Bosch and Ding do not teach that an etchant comprising  $C_2H_xF_y$ , where  $x$  is an integer from 3 to 5, inclusive,  $y$  is an integer from 1 to 3, inclusive, and  $x + y = 6$ , is used to dry etch doped silicon dioxide with selectivity over undoped silicon dioxide, as is recited in both independent claims 1 and 20.

In the Examiner's answer, it has been asserted that Appellants have not traversed the assertion that Ding teaches  $C_2H_4F_2$  and, thus, reads on the limitations of claims 1-38 requiring that an etchant comprise " $C_2H_xF_y$ , where  $x$  is an integer from 3 to 5,  $y$  is an integer from 1 to three, and  $x + y = 6$  . . ." While it is, and repeatedly has been, acknowledged by Appellants that Ding teaches the use of  $C_2H_4F_2$  as an etchant, the fact remains that Ding's teachings are severely limited to the use of  $C_2H_4F_2$  for etching doped silicon dioxide or undoped silicon dioxide with selectivity over photoresist materials. Ding does not disclose, teach, or suggest that  $C_2H_4F_2$  may be used to etch doped silicon dioxide with selectivity over, or at a faster rate than, undoped silicon dioxide.

Nonetheless, as has been the typical course of prosecution in the above-referenced application, the fact that the dry etchants of claims 1-38, which comprise  $C_2H_4F_2$ , must also be

formulated to etch doped silicon dioxide with selectivity over at least undoped silicon dioxide (claim 1) or to etch doped silicon dioxide at a faster rate than undoped silicon dioxide (claim 20) has been overlooked by the Examiner. Thus, when the subject matter recited in claims 1-38 is considered in its entirety, the fact that Ding teaches that  $C_2H_4F_2$  may be used to dry etch either doped silicon dioxide or undoped silicon dioxide is completely irrelevant. Thus, there has been no reason for Appellants to traverse this teaching of Ding.

To reiterate, while Ding discloses an etchant comprising  $C_2H_4F_2$ , which is a  $C_2H_xF_y$ , where  $x$  is an integer from 3 to 5, inclusive,  $y$  is an integer from 1 to 3, inclusive, and  $x + y = 6$ , Ding does not disclose that this etchant is used to etch doped silicon with selectivity over undoped silicon dioxide. Conversely, Bosch discloses that its etchant selectively etches doped silicon dioxide over undoped silicon dioxide. However, Bosch does not disclose an etchant comprising  $C_2H_xF_y$ , where  $x$  is an integer from 3 to 5, inclusive,  $y$  is an integer from 1 to 3, inclusive, and  $x + y = 6$ . In addition, as previously discussed, there is no motivation in Bosch, Ding, or the knowledge generally available to one of ordinary skill in the art to combine Ding and Bosch to produce the claimed invention.

Therefore, Appellants submit that the cited references do not teach or suggest all the limitations of the claimed invention and, therefore, the obviousness rejection of claims 1 and 20 should be withdrawn. Claims 2-19 and 21-38 are each allowable, among other reasons, as depending either directly or indirectly from claims 1 and 20, respectively

3. *Additional Arguments for Reversing the Claim Rejections Were Not Addressed in the Examiner's Answer*

Additional arguments were presented in the Appeal Brief with respect to the impropriety of the 35 U.S.C. § 103(a) rejections at issue in the above-referenced patent application.

However, some of these points were not addressed in the Examiner's Answer.

Specifically, the Examiner's Answer did not respond to the argument that a reasonable expectation of success, which is one of the required criteria for establishing a *prima facie* case of obviousness, was not established. As previously described, no support has been provided to show that  $C_2H_xF_y$  would be useful as a dry etchant or in a dry etchant chemical combination to etch doped silicon dioxide. Therefore, by necessity, no support has been provided for using this dry etchant chemical combination to etch the doped silicon with selectivity over undoped silicon.

The Examiner's Answer also did not address the argument that there was no motivation to modify the etchant system disclosed in Bosch because that system achieved the desired result.

In addition, the Examiner's Answer did not address the argument that the cited references teach away such a combination. Specifically, the chemical etchant disclosed in Bosch, which does not include  $C_2H_4F_2$ , is disclosed to etch doped silicon dioxide with selectivity over undoped silicon dioxide. In contrast, Ding teaches that its chemical combinations, which may include  $C_2H_4F_2$ , are useful for etching both doped silicon dioxide (BPSG) and undoped silicon dioxide with selectivity over other materials, such as resist materials. Column 3, lines 57-61. Since Ding discloses that its dry etchant chemical combination etches both doped and undoped silicon

dioxide, it teaches away from using  $C_2H_4F_2$  to etch doped silicon dioxide with selectivity over undoped silicon dioxide.

The Examiner's Answer also did not address the argument that the selectivities of the etchant systems that are disclosed in Bosch and Ding are different. While Bosch teaches an etchant system that is useful for selectively etching doped silicon oxides over undoped silicon dioxides, Ding discloses etchant systems that are useful for selectively etching dielectric materials, which include both doped and undoped silicon oxides, over photoresist materials and polysilicon. Since Ding does not disclose that its etchant systems selectively etch doped silicon over undoped silicon, the operative principles underlying the references are different.

Finally, the Examiner's Answer did not address the argument that Ding teaches that etch rates are increased by a  $NH_3$  compound undergoing liquefaction upon the surface of the substrate, whereas Bosch teaches gaseous interactions of  $CHF_3$  and neon. Therefore, the proposed combination of Ding and Bosch would modify the principle of operation of the prior art invention being modified and, therefore, the "teachings of the references are not sufficient to render the claims prima facie obvious." M.P.E.P. §2143.01 (citing *In re Ratti* , 270 F.2d 810, 123 USPQ 349 (CCPA 1959).

The respective discussions of these points, as presented in the Appeal Brief, are reasserted herein.

4. *Rejection of claims 10, 12, 14, 15, 17-19, 29, 31, 33, 34, and 36-38*

Appellants respectfully submit that the nonobviousness of independent claims 1 and 20 precludes the rejection of claims 10, 12, 14, 15, 17-19, 29, 31, 33, 34, and 36-38 because a dependent claim is obvious only if the independent claim from which it depends is obvious. *See In re Fine*, 5 U.S.P.Q.2d 1596, 1600 (Fed. Cir. 1988); *see also* M.P.E.P. § 2143.03.

## II. CONCLUSION

It is respectfully submitted that a *prima facie* case of obviousness of claims 1-38 has not been established under 35 U.S.C. § 103(a) because there is no motivation to combine the cited references, there is no reasonable expectation of success, and the cited references do not teach or suggest all the limitations of the claimed invention. Therefore, it is respectfully requested that the Board reverse the 35 U.S.C. § 103(a) rejections of claims 1-38.

Respectfully submitted,



Brick G. Power  
Registration No. 38,581  
Attorney for Appellant  
TRASKBRITT, P.C.  
Salt Lake City, Utah 84110-2550  
Telephone: (801) 532-1922

Date: February 19, 2002  
BGP/djp

N:\2269\3526.4\Reply Brief.wpd 2/16/02